WHAT IS CLAIMED IS:

1. A holographic imaging spectrometer comprising:

(a) a four-dimensional (4D) probing source object;

(b) a holographic element comprising one or more recorded holograms configured to receive and diffract an optical field emitted from the 4D probing source object into one or more diffracted plane beams having spectral information;

(d) collector optics configured to:

(i) focus the one or more diffracted plane beams having spectral information to a two-dimensional (2D) slice (having spectral information) of the 4D probing source object; and

(ii) project the focused 2D slice having spectral information onto a detector; and

(e) the detector configured to receive the focused and projected 2D slice.

2. The spectrometer of claim 1, wherein one of the recorded holograms was recorded by interfering a monochromatic point source signal beam and a plane reference beam.

3. The spectrometer of claim 1, wherein one of the recorded holograms was recorded by a pre-designed or computer generated signal and a reference wavefront.

4. The spectrometer of claim 1, wherein:

the one or more recorded holograms are multiplexed within the holographic

element;

the one or more recorded holograms are arranged to extract a corresponding slice of the 4D probing source object; and

the one or more recorded holograms are arranged to diffract light from the corresponding slice of the 4D probing source object to a non-overlapping section of the detector.

5. The spectrometer of claim 1, further comprising objective optics configured to process the optical field emitted from the 4D probing source object;

6. The spectrometer of claim 5, wherein the objective optics comprises a collimating lens configured to collimate the optical field.

7. The spectrometer of claim 1, wherein the objective optics is part of the holographic element.

8. The spectrometer of claim 1, wherein the diffraction by the one or more holograms is based on one or more Bragg degeneracy properties.

9. The spectrometer of claim 1, wherein the collector optics is part of the holographic element.

10. The spectrometer of claim 1, wherein the collector optics comprises an

imaging lens.

11. A method for imaging a four-dimensional object comprising:

emitting an optical field from a four-dimensional (4D) probing source object;

receiving the emitted optical field in a holographic element

diffracting the received optical field in the holographic element to one or more diffracted plane beams having spectral information;

focusing the one or more diffracted plane beams having spectral information to a two-dimensional (2D) slice (having spectral information) of the 4D probing source object; and

projecting the focused 2D slice having spectral information onto a detector.

12. The method of claim 11, wherein one of the recorded holograms was recorded by interfering a monochromatic point source signal beam and a plane reference beam.

13. The method of claim 11, wherein one of the recorded holograms was recorded by a pre-designed or computer generated signal and a reference wavefront.

14. The method of claim 11, wherein:

the one or more recorded holograms are multiplexed within the holographic element;

the one or more recorded holograms are arranged to extract a corresponding

slice of the 4D probing source object; and

the one or more recorded holograms are arranged to diffract light from the corresponding slice of the 4D probing source object to a non-overlapping section of the detector.

15. The method of claim 11, further comprising the step of processing the emitted optical field through objective optics.

16. The method of claim 15, wherein the objective optics comprises a collimating lens configured to collimate the emitted optical field.

17. The method of claim 15, wherein the objective optics is part of the holographic element.

18. The method of claim 11, wherein the diffraction by the one or more holograms is based on one or more Bragg degeneracy properties.

19. The method of claim 11, wherein the focusing step is performed within the holographic element.

20. The method of claim 11, wherein the focusing step is performed using an imaging lens.

21. An apparatus for imaging a four-dimensional object comprising:

means for emitting an optical field from a four-dimensional (4D) probing source object;

means for a holographic element to receive and diffract the optical field into one or more diffracted plane beams having spectral information;

means for focusing the one or more diffracted plane beams having spectral information to a two-dimensional (2D) slice (having spectral information) of the 4D probing source object; and

means for projecting the focused 2D slice having spectral information onto a detector.

22. The apparatus of claim 21, wherein one of the recorded holograms was recorded by interfering a monochromatic point source signal beam and a plane reference beam.

23. The apparatus of claim 21, wherein one of the recorded holograms was recorded by a pre-designed or computer generated signal and a reference wavefront.

24. The apparatus of claim 21, wherein:

the one or more recorded holograms are multiplexed within the holographic element;

the one or more recorded holograms are arranged to extract a corresponding slice of the 4D probing source object; and

the one or more recorded holograms are arranged to diffract light from the corresponding slice of the 4D probing source object to a non-overlapping section of the detector.

25. The apparatus of claim 21, further comprising means for processing the emitted optical field.

26. The apparatus of claim 25, wherein the means for processing comprises means for collimating the optical field.

27. The apparatus of claim 25, wherein the means for processing is part of the holographic element.

28. The apparatus of claim 21, wherein the diffraction by the one or more holograms is based on one or more Bragg degeneracy properties.

29. The apparatus of claim 21, wherein the means for focusing are part of the holographic element.

30. The apparatus of claim 21, wherein the means for focusing comprises an imaging lens.